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THE THREE R'S

by

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THE THREE R'S

CONCERN over the failure of many American students to acquire proficiency in the basic skills of learning has inspired a country-wide effort to strengthen instruction in the three R's at all levels of the educational process. The national need for more highly trained men and women; complaints that Johnny never learned to read, or write, or do sums properly; biting criticism of prevailing school practices by crusaders for "basic education" have all contributed to a revival of emphasis on "reading, 'riting and 'rithmetic."

Revision of curricula has been the main theme of most educational conferences in recent years. At the local level school authorities have been re-assessing their programs and teaching techniques. Many school systems are introducing new teaching materials and sending teachers to special workshops to acquaint them with new methods of teaching the basic subjects. Thousands of special studies have sought to define more clearly the processes by which children learn to read, to comprehend written material, to express themselves clearly, and to deal with fundamental principles of mathematics.

Subject-Centered vs. Child-Centered Schooling

Reforms in teaching the three R's are being introduced while debate continues over the values of "child-centered" vs. "subject-centered" education. This larger controversy is far from being resolved but it is clear that demands for tougher, more disciplined instruction in basic subjects are having profound effects on school programs.

Elementary school heads all over the country are watching an experimental program instituted this year at the Amidon School in Washington, D. C. The program was set up to test the belief of the local superintendent, Carl F. Hansen, that children learn better and faster if taught by more direct and more concentrated methods.

The prospectus of the Amidon School contains this key paragraph:

> Only the most essential skills and knowledge can adequately be taught in the school day. . . . Intelligent behavior is possible only if the individual acquires surely and systematically the tools which make such behavior possible. These are language and the number systems, which unlock the knowledge and experience man has acquired and preserved and which make it possible to expand and refine that experience.

While Superintendent Hansen describes the Amidon program as one "combining the best of the old and the new," the program itself leans heavily toward the subject-centered concept. If successful, it will be extended to all of Washington's public schools.

Call for Change in School Methods and Curricula

The main issue engaging the attention of educators was thrust into the open last April by publication of a report prepared by the San Francisco Curriculum Survey Committee for the city's Board of Education. The committee of eight university professors recommended greater emphasis on teaching academic subjects and the basic skills. Elementary schools should devote at least two-thirds of the day to reading, writing and arithmetic (the state requires a minimum of a half-day); should drop such projects as visiting the post office and building Indian villages. High schools should require four instead of three years of English, with more emphasis on written assignments; college-bound students should be required to take four years of mathematics. Elimination of "goals courses," such as driver training and consumer education, was urged so as to leave more time for the solid subjects.

The San Francisco school superintendent approved most of the major recommendations for high schools but defended the elementary schools against the inference that they were weak in teaching basic skills. The California Teachers Association's Commission on Educational Policy criticized the report because its authors appeared "to take no responsibility for citizenship education or for moral and spiritual values."

Recent reports by James Bryant Conant on the country's secondary school systems[1] have strengthened the movement

[1] James Bryant Conant. *The American High School Today* (1959) and *Education in the Junior High School Years* (1960).

for reform of their curricula. Conant's recommendations stressed the need for greater attention to English and mathematics. At the same time he recognized the responsibility of American schools for a segment of the population which lacks the capacity to do well in academic subjects.

Meanwhile the National Education Association, which has generally favored the broader concept of child-centered education, has set up a Special Project on the Instructional Program to study current practices and recommend necessary changes. The N.E.A. executive secretary, William Carr, has said: "Many voices are heard. . . . Some call for a return of the so-called solid subjects. . . . Some ignore what we know about the learning process. It is time for the teaching profession itself to examine current changes in school programs and to recommend curriculum and organization of subject matter." [2]

That there is room for change at the lower levels of American education is shown by a new study of the country's graduate schools, *Graduate Education in the United States*, by Bernard Berelson of Columbia University. He remarks on the "writing deficiencies" of graduate students and continues: "Poor writing and the associated bad organization of . . . scholarly reports is so general . . . , so indicative of unclear thinking and analysis, and so costly of the time and resources of others that some intensive efforts at improving the situation seem to be required."

Reading Deficiencies of American Youth

THE CONTROVERSY over basic education generates greatest heat when prevailing methods of teaching children to read are brought under attack. Popular interest centers on the reading problem because many parents fear that their children's future success is being jeopardized by faulty reading instruction. The growing practice of grouping children according to reading skill and setting up different programs for fast, average and slow learners has heightened parental concern.

It is widely recognized that reading skill is fundamental

[2] Report to N.E.A. convention, Los Angeles, June 26-July 1, 1960.

to achievement in all fields of learning. Former Harvard President Conant has stated that any child whose reading is not up at least to sixth-grade level is certain to fail in high school; reading ability must rise well above the sixth-grade level if the student is hoping to go to college.

Emotional disturbance and juvenile delinquency have been widely linked to poor progress in reading. More than 150 research studies support the contention that lack of competence in reading is a major cause of pupil drop-out in high school.[3] An official report to the mayor of New York in 1955 said "Failure in reading accounts more than any other single factor for behavior problems, truancy, and general school failure." Experts do not agree, however, on whether reading failure is the cause or the effect of personality distortion.

Public interest in reading instruction was first aroused five years ago with publication of Rudolf Flesch's *Why Johnny Can't Read*. This attack on prevailing methods of reading instruction became a best-seller despite condemnation by leaders of the teaching profession. Flesch was accused of being a sensationalist who exaggerated the shortcomings of reading instruction and offered an oversimplified panacea—phonics instruction—for all reading problems. Defenders said Flesch was compelled to resort to shock treatment to bring a serious problem sharply to public attention.

Since *Johnny* came out in 1955 a number of more restrained analyses have been published for popular consumption. These have directed attention to certain experimental programs said to be far more effective in developing good readers than the conventional methods used by most schools. Some of the later books were written by specialists in reading who sought to put their case before the public because their earlier technical reports to the profession had been ignored.

Complaints of Poor Reading; Search for Causes

Educators disagree on the extent of low reading ability among American students. Several studies have indicated that today's students read at least as well as their predecessors of the rote-and-drill era in education. This conclusion is questioned by some critics who point to the re-

[3] Glenn McCracken, *The Right to Learn* (1959), p. 1.

peated simplification of textbooks as evidence of the schools' efforts to accommodate themselves to students' diminishing ability to read. There is general agreement, however, that the times demand a high level of reading skill and that by and large American youngsters could do far better.

Widespread adoption of remedial reading classes in high school is one evidence of dissatisfaction with the results of early reading instruction. Colleges also have instituted remedial classes because many incoming students are not able to use textbooks effectively. One study showed that one-fifth of a class of college freshmen were reading below the eighth-grade norm; others read so slowly that they were hampered in their studies.[4]

Conant wrote that in some of the schools he had surveyed, 35 to 50 per cent of the ninth-graders read at sixth-grade or lower levels. The New York City system reported last May that more than one-fourth of its junior high school students were two and a half years behind in reading; the average seventh-grader was a year behind. The city has set up reading clinics in many schools and sends out teams of specialists to help teachers cope with reading retardation. Conant believes it imperative that all English teachers in high school be prepared to teach reading skills, especially to pupils of below-average ability, but few English teachers possess the necessary training in this field.

Thousands of studies have been undertaken to find the causes of backwardness in reading. In the case of New York, the fault lies in part with the foreign language background of many students. Most reading specialists attribute poor achievement to a complex of interrelated causes. Among them are low mental capacity (although many poor readers score well above the average I.Q.), poor vision or hearing, other physical deficiencies such as chronic infection, emotional disturbances sometimes arising out of home tensions, environmental factors such as broken homes, too much moving from one school to another, and cultural deprivation of the family.

Many critics would discard virtually all of the above asserted causes and center the blame on faulty instruction. Any normal child, properly taught, can become a reasonably good reader, it is said, even if he suffers emotional,

[4] Paul A. Witty, "The Improvement of Reading Abilities," *Yearbook of the National Society for the Study of Education* (1956), p. 252.

physical or environmental handicaps. Reports of results in certain experimental programs indicate that pupils with I.Q.s in the lower 80s score above national norms when properly taught. The same reports state that many emotional difficulties, including the so-called "emotional block to learning," disappear or are greatly alleviated when the child experiences the satisfactions of actually applying, in practice, the ability to read.

Look-Say vs. Letter-Sound Instruction

Critics of prevailing methods of teaching children to read assert that the greatest error is beginning with "look-say" rather than phonic instruction. Under the look-say method, the child is taught to recognize whole words and phrases from their general appearance; under the phonics method he begins by learning the sounds associated with letters and combinations of letters. A considerable body of research and specialist opinion upholds both approaches and, in actual practice, most schools use them in combination. But there are great differences in the degree of emphasis placed on phonics, and how early in the program full-scale phonics instruction is given.

Systems which rely chiefly on look-say at the beginning with phonics instruction slipped in later, are said by their critics to slow up progress in the early grades and in many cases to delay acquisition of higher reading skills at later stages of schooling. Some children, it is said, encounter difficulty when they must break the habit of trying to recognize words from their general appearance and begin tackling the words phonetically. Numerous cases are cited of mature students who are stumped by relatively simple words—reading *majesty* for *mystery*, *college* for *cottage*, even *feet* for *feel* because these pairs of words look alike.

Defenders of the prevailing system say that phonics drill at the beginning of instruction would create a class of readers who could say the words without understanding them. A recent editorial in a professional journal cited the complaint in 1838 of Horace Mann that "more than 11/12s of the children in the reading classes in our schools do not understand the meaning of the words they read because teachers have over-emphasized the A.B.C.s." The editorial commented: "Not heeding Mann's admonition about comprehension could account for the phonetic pana-

ceas so glibly voiced during the past decade." [5] On the other side, proponents of a phonics approach state: "In learning to read, the child needs a skill of turning letter-symbols into sound-symbols. This is first. It is basic. When he has this skill, be it ever so mechanical, he is ready to read for meaning." [6]

Support for Earlier Start on Learning to Read

Another argument among educators is over the question of when to begin teaching a child to read. American education is fairly well committed to the principle that children vary in the age at which they are ready for certain types of instruction. The effect is to put off instruction in reading for pupils considered unready for it.

Many schools give standardized tests to separate pupils who are to be launched on reading from those to remain in a "reading-readiness" program. The criterion is chiefly the ability of the child to distinguish symbols of different shapes. With some children, it is felt, the physical structure of the eye has not matured enough for reading even if they are past the sixth birthday.

Considerable criticism has been directed at the concept of reading readiness and there is a growing conviction in some educational circles that the teaching of reading is being needlessly delayed for many children. One educator has asserted that "The use of inaccurate, misleading measuring criteria [for reading readiness] determines the fate of thousands upon thousands of American school children during the very first week of . . . school." [7] He notes that many children who could not pass a reading readiness test did learn to read successfully in his school. Other proponents of special methods of reading instruction make similar claims.

Not a few educators are coming to think that schools have underestimated the young child's capacity to learn in many areas of study. In some communities parents have brought pressure on school authorities to initiate reading instruction at an earlier age, even in kindergarten. Other parents have disregarded the advice of school authorities and taken on themselves the task of teaching pre-schoolers to read.

[5] "A Hundred Years Later." *The Reading Teacher*, February 1960, p. 169.
[6] Sibyl Terman and Charles Child Walcutt, *Reading: Chaos and Cure* (1958), p. 61.
[7] McCracken, *op. cit.*, p. 71.

The Educational Policies Commission of the National Education Association recently took note of the growing pressure on elementary schools from a public which "demands that schools require more of each pupil and that more be taught in more rigorous fashion." The commission had this to say about early reading instruction:

> Research . . . shows that some children gain from an early start. Others who start early, however, do not in the long run progress so rapidly. . . . Still others are not ready to learn to read even in the first grade. . . . The claim of reading to a place in the kindergarten must be assessed in terms of the individual child's ability to profit from reading instruction . . . [and] the role which the kindergarten is peculiarly adapted to fill.[8]

This is in general the view that prevails in the schools. But critics consider statements of this kind from large educational organizations a protective cover for practices which in their opinion needlessly delay mastery of reading skills.

Teaching Techniques to Turn Out Good Readers

New instructional programs for beginning readers and retarded readers have been developed over the past decade. Many of these have been used experimentally in certain schools and the instructional materials—texts, readers, slides, drill cards, teacher guides, and so on—are available to all school systems.

Glenn McCracken, originator of the system used in the public schools of New Castle, Pa., has challenged school authorities everywhere to accept his system—with a guarantee to improve the reading achievement of beginners at least 30 per cent, probably 40-50 per cent. In addition, he would guarantee that the advanced level would be maintained in succeeding grades. McCracken is reported to have made good his claims at more than 20 schools which have adopted his system.

The New Castle system, launched experimentally 12 years ago, uses film strips to project the reading lesson on a screen. McCracken objects to dividing classes into slow, average and fast readers, so gives the same lesson to all children in a class at the same time. The success of the system is said to be most marked with low and average I.Q. children.

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[8] Educational Policies Commission, *Contemporary Issues in Elementary Education*, Sept. 2, 1960, pp. 11-12.

The reading system recommended by Flesch and others is the Hay-Wingo system, first used experimentally in several school systems in Illinois and later adopted by other schools, including remedial reading classes. The system teaches the sounds of letters and combinations of letters from the very beginning, putting the children through plenty of drill before stories are read. Summer workshops to prepare teachers in use of the system are held at Monmouth College, Illinois, where Charles Wingo, co-creator of the Hay-Wingo reading system, is a professor of education.

The experimental Amidon School in Washington, D. C., engaged one of the originators of the Phonovisual Method to train elementary teachers for its new reading program.[9] The Phonovisual Method was developed at the Primary Day School in suburban Bethesda, where all pupils, including some who had been reading failures at other schools, became proficient readers. It relies heavily on training in letter sounds.

Reforms in reading instruction are not limited to techniques for teaching beginners; they include methods of refining and deepening the older student's use of his reading skill. Many junior high schools employ the so-called "developmental reading" program for this purpose. Educators agree that "No other single program . . . [has] as far-reaching an effect on improvement of the total teaching-learning situation in the school." [10]

Developmental reading takes many forms. It may include remedial reading for below-par students, speed reading for competent students, and differential reading in which the student is taught to read differently for facts, for general knowledge, for details, and for pleasure. Many schools have adopted "free reading" periods to encourage students to read for their own pleasure. Specific instructions are given to help the students summarize what they have read, to develop a critical approach to the material, to search for the author's motives, to seek proof of generalized statements.

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[9] Reading instruction at the Amidon School begins with study of the alphabet, phonetics and syllabication but, according to the prospectus, "meaning [will be] a paramount element in such instruction." The method "will combine seeing and sounding" and "the meaning of words will, where necessary, be taught by the teacher."

[10] Carl J. Freudenreich (supervisor of English, New York State Education Department), "How Can a Junior High School Staff Get a Schoolwide Developmental Program Under Way?" *Improving Reading in the Junior High School* (1957), p. 85.

Deficiencies in Ability to Write

NEXT TO READING, nothing so distresses the post-elementary school teacher as the inability of students to express themselves correctly and with precision in writing. Many non-credit courses given college freshmen cover grammar, sentence structure, punctuation and paragraphing—subjects which were once the mainstay of lower school programs. Colleges blame the high schools for sending them students otherwise able, who come close to illiteracy when they write. High schools complain that elementary schools send them boys and girls who do not know the difference between a clause and a sentence.

There are many signs that the schools are getting into action on the writing problem and money from philanthropic foundations is beginning to flow into efforts to correct writing inadequacies. The Ford Foundation, for example, financed a series of meetings of English teachers during 1958 to consider "basic issues in the teaching of English." The teachers, sponsored by four leading educational organizations, noted the low state of student literacy—even though language is the one subject taught consistently in every grade. They wrote in their final report:

> Some hostile critics have said that if as much student time were spent on any other subject with so little in the way of results, it would be a national scandal. . . . Everybody, including the English teachers, complains that students do not know how to read or write. . . . Some of us in the profession believe that a thorough re-examination of the whole problem of teaching English, from the elementary grades through graduate school, is now imperative.[11]

Reporting on results of a test given students at the University of North Carolina, one professor wrote that most of the students "can neither sort out . . . particulars nor select appropriate generalizations . . . cannot recognize the effect of transitional expressions or the tense of verbs on the order of sentences." With most, the arrangement of materials in a theme was "by free association, a kind of verbal fingerpainting." [12]

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[11] American Studies Association, College English Association, Modern Language Association, and National Council of Teachers of English, *The Basic Issues in the Teaching of English*, September 1959, p. 5.

[12] George F. Horner, "Language Arts Skills Needed by College Freshmen," *North Carolina English Teacher*, February 1959, reported in *The English Journal*, November 1959, p. 484.

Superintendent Hansen of the Washington school system, after reviewing 5,000 themes written by local high school students, said: "Greater proficiency in the craftsmanship of writing is clearly needed. . . . The students seemed to have little skill in the organization of thought in appropriate structural relationships. Short, choppy sentences or indiscriminate coordination in run-on sentences were all too common. . . . I saw little evidence that the students had learned how to use varieties of grammatical construction to establish transition, to sharpen emphasis, to make for variety . . . or to place the thought values in their proper relationships." Also deplored by Hansen was the apparent lack of emphasis in the school room on "routine mechanics"—margins, indentations, headings, penmanship.

Pressures for Heavier Assignments in English

The chief reason students do not learn to write is that not enough is expected of them in writing and in rewriting after correction. "Every day . . . students confess that until enrolling in college they had never written a theme," an English teacher has said. "High school students have too few opportunities to write legible, literate, coherent papers in which they are held responsible for correct spelling, proper punctuation and intelligent adherence to form. Rarely do they receive any sort of critical analysis of their written work or the opportunity for revision. . . . To these students the demands made by college instructors are overwhelming." [13]

As a remedy, Conant has recommended that half of the time in high school English classes be given to composition. "Each student should be required to write an average of one theme a week. . . . A schoolwide composition test should be given in every grade. . . . Those students who do not obtain a grade on the 11th grade composition test commensurate with their ability as measured by an aptitude test should be required to take a special course in English composition in the 12th grade." [14]

Some educators feel that if the colleges would drop remedial English courses for laggard freshmen, the secondary schools would be brought under pressure by parents to give

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[13] Alice Edwards (Ohio State University), "A Matter of Literacy," *Educational Research Bulletin*, Jan. 13, 1960, p. 11.

[14] James Bryant Conant, *The American High School Today* (1959), pp. 50-51.

more writing instruction so that their children could qualify for college entrance. The University of Illinois has already dropped its remedial English course. The director of freshmen composition at Ohio State has conferred with high school authorities to help them plan English courses that will better prepare students for college work. A booklet, *Freshman English at the Ohio State University*, has been widely distributed to acquaint students and teachers with standards of the university; it contains numerous examples of actual themes which have been written by college freshmen and which have been graded and marked for errors.

Use of short-answer tests and audio-visual teaching materials is sometimes blamed for the downgrading of good reading and writing as the basis of American education. Philip Marson, veteran teacher at Boston Latin School, recently retired, puts some of the blame on the College Entrance Examination Board for dropping the essay test. But the College Board for years has been trying to develop suitable tests of language ability and more than 100 colleges this year required a sample of student writing as part of the entrance examination administered by the board.

Emphasis on Writing in Elementary Schools

The revived emphasis on writing reaches down from university to elementary school. Professional journals carry many reports from teachers who have tried new ways of getting young children to express themselves effectively in writing. There is great interest among teachers in the language arts program developed for fourth-, fifth- and sixth-graders at the Francis Parkman School in Boston. This program was undertaken experimentally in 1949 and the methods devised have been successfully tested in a number of Boston's public schools. The pupils learn not only the formal rules—grammar, sentence structure, spelling and so on—but are trained also in observation and selective use of words and phrases.

Teaching materials developed at the Parkman School have been widely distributed. Some of these are used in the Amidon School in the District of Columbia. Reforms in teaching of the three R's introduced at that school include commencement of formal lessons in grammar and sentence diagramming in the fourth grade.

RESORT TO LAY READERS TO CORRECT SCHOOL PAPERS

One of the problems in expanding composition programs in high schools is finding enough teacher time to correct student papers. The average high school teacher has at least 150 students and the student load will rise in future years. It has been estimated that a teacher with an average load who assigns each student one short paper a week will have to spend three hours each school night and nine hours over week-ends correcting compositions. A solution under study by the Educational Testing Service involves use of lay readers for this purpose.

Under the lay-reader plan, teacher assistants are recruited from among college-trained housewives screened for language ability. In an experimental program, which extended to 8,000 students in 16 cities, the readers were paid 25c for each corrected paper (10c for checking a rewritten paper) and $1.50 an hour for conferences with students and teachers. Costs ran about $5 a year a student.

The so-called Rutgers Plan for Reducing Class Size, now being tried in selected high schools in Chicago and Detroit, has attracted wide attention. It was developed during the summer of 1959 at Rutgers University, where 63 English teachers, recipients of Ford Foundation grants, met at a workshop on problems in teaching English. Under the Rutgers plan, students and teacher meet in conventional classes only twice a week. On two days, students gather in groups of 200, supervised by college-trained teacher aides (housewives), for "free reading." One day a week they are tested, correct homework and are drilled in fundamentals of language by the aides, working part-time. A paper is assigned every two weeks, three out of four to be corrected by the lay reader, one to be corrected by the teacher.

The chief advantage of the Rutgers plan is that the teacher never meets with more than 25 students at a time. It has been criticized because it reduces teacher-student contact and relegates important teacher duties to the aides. A defender says: "The plan does not envision the existence of any more English teachers than are currently available. The cost will be well within the financial resources of the average community." [15]

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[15] Paul B. Diederich (research associate, Educational Testing Service), "The Rutgers Plan for Cutting Class Size in Two," *English Journal*, April 1960, p. 229.

Coming Revolution in Mathematics Instruction

REFORMS in teaching mathematics, some of them still in the experimental stage, promise even more radical changes than those affecting instruction in English. Major investigations have produced new teaching materials that break completely with past methods of mathematics instruction. So great is the interest of high schools in the new materials that leaders of curriculum-revision projects have warned against undue haste in overhauling mathematics programs; sweeping change would be disruptive unless teachers were fully prepared for it.[16]

The U.S. Office of Education and the National Council of Mathematics Teachers called a conference of specialists last March to deal with the teacher re-education problem, in the light of anticipated revisions of mathematics curricula. "Our school mathematics teachers do not have enough mathematical power to adapt to the demands of a new curriculum," the keynote speaker said. The need for in-service training was presented as urgent. "If a student is not already pretty good in mathematics before he leaves high school, there is little that college mathematics can do to retrieve him as a scientist. . . . Thus, the secondary school teacher is perhaps the key person in determining our national scientific and technological strength." [17]

The March conference drew up a number of recommendations to the nation's schools on how to organize in-service training programs for math teachers and listed sources of new mathematics materials.

Strong Movement to Replace Outdated Systems

The impetus for the big change in mathematics teaching came from sudden realization that traditional courses were antiquated, included much that had been discarded by working mathematicians and excluded much that was needed for genuine comprehension of what mathematics is all about. While the modernization effort was largely aimed at improving the preparation of future scientists and tech-

[16] According to the U.S. Office of Education, nine out of 10 elementary and secondary school teachers of mathematics are in need of some re-education. A random survey of 4,200 high schools in 1958 showed two-fifths were planning or conducting curriculum revision projects in mathematics.

[17] W. J. Duren (dean of College of Arts and Sciences, University of Virginia), conference on in-service teaching of mathematics teachers, Washington, March 17-19.

nicians for advanced study in college, it was concerned also with broadening the understanding of mathematics among all students, on the theory that a discipline which affects so many aspects of modern life should be accessible to all educated persons.

A secondary purpose is to find ways of arousing student interest in the science of mathematics. In high schools, mathematics courses have long been least popular of all. Investigations have disclosed two reasons: (1) an ingrained conviction that math is too difficult and that the average person has no need of more than basic arithmetic skills; (2) the content of present courses and methods of teaching are too dry to interest the average student. Mathematics has been taught chiefly as a series of operational tricks, requiring the memorization of rules and repeated drill in computation with no understanding of the fundamental principles.

The new approach to mathematics attempts to tear the veil from the "secret world" in which real mathematicians operate. It has to do with the nature of mathematical thinking, the meaning of mathematical symbols, the basic concepts which govern the solution of problems. "Conceptual insight" is a favorite phrase used by mathematicians to describe goals of the new curricula. "To nourish the growth of these [mathematical] concepts, to develop their relation to the problem-solving process and to open inviting channels of investigation and study will stir the imagination of the students." [18]

PROJECTS TO MODERNIZE MATHEMATICS COURSES

Revision of mathematics teaching methods has engaged the joint efforts of leading educators, professional mathematicians, and specialists from various fields allied to mathematics. Never before has a single discipline been subjected to such extensive overhauling.

The four most influential projects in the field of mathematic curriculum revision are the following:

School Mathematics Study Group based at Yale University and set up with a grant from National Science Foundation. An advisory committee of 35 drew up the plan

[18] Harold P. Fawcett (professor of mathematics education, Ohio State University), "Mathematics in General Education," *New Developments in Secondary-School Mathematics* (1959), p. 33

of the study and more than 100 mathematicians and math teachers contributed to preparation of textbooks which emphasize "mathematical structure, the nature of inductive and deductive reasoning, and the precision of mathematical language." The new courses, tried out in 50 experimental centers during the 1959-60 school year, were revised last summer. Complete sequence of teaching materials from grades 7 through 12 available.

University of Illinois Committee on School Mathematics, sponsored by Carnegie Corporation. Material developed has been tested in senior high schools in several states. Textbooks emphasize "consistency, precision of language, structure of mathematics, and understanding of basic principles through pupil discovery."

Commission on Mathematics of College Entrance Examination Board, formed to develop recommendations for modernization of college preparatory courses in high schools. Report in the spring of 1959 recommended modifications of existing curricula for greater stress on deductive reasoning, fundamental concepts, and such modern subjects as descriptive statistics, statistical inference, and the properties of sets.

University of Maryland Mathematics Project, financed by Carnegie Corporation, for development of new curricula for grades 7 and 8. Content of texts produced by the project differs greatly from the traditional. Among subjects studied by seventh-graders are systems of numeration, properties of natural numbers, factoring and primes, logic and number sentences, and scientific notation for arithmetic numbers. New courses recently introduced in Maryland, Virginia and District of Columbia public schools.

One of the most interesting fruits of the curriculum revision movement has been a growing conviction that certain abstract mathematical concepts can be learned at very early ages. Much attention has centered on experiments of Syracuse University's Madison Project, which has successfully introduced the study of algebra as far down the educational ladder as the third grade. The project was started in 1957 as an experimental program for low-I.Q. seventh-graders. Their interest and performance took a sharp upward turn when teachers dropped remedial arithmetic and began to teach something about algebra. More recently the project has worked with average and high-I.Q. students.

A major discovery, according to the Madison Project's director, has been that the ideal place to introduce abstract mathematics is grades four or five. Algebra is actually easier for fourth-graders than for children in the seventh grade and they get a firmer grip on the essential nature of mathematical thought. "Our fourth grades . . . easily discover for themselves how to solve quadratic equations and they derive unmistakable pleasure from this sort of activity." [19]

The project has prepared a two-year sequential course in algebra through which the student learns mainly from his experiences in analyzing a series of problems. "This course has been taught with notable success to gifted fourth- and fifth-graders, to low-I.Q. seventh-graders and to many other groups, beginning as early as grade three and including a full range of I.Q.s." [20] The materials can be used in toto or in part as occasional enrichment of a regular course. They are being adopted by a growing number of schools, including some in New York, Connecticut, Texas and a number of foreign countries.

Distribution of Teaching Reform Efforts

Numerous other mathematics teaching reform efforts are under way in colleges and universities and various school systems. The U.S. Office of Education recently issued an incomplete list of current projects which cited more than 60 schools and school systems trying in some way to improve mathematics instruction, most of them at the secondary level. The weakest link is the elementary school, whose teachers are least well equipped to take on innovations.

A new program to strengthen the teaching chain was announced, Aug. 30, by the Mathematical Association of America. Aided by a $350,000 grant from the National Science Foundation plus funds from the Ford Foundation, the association will undertake a two-year "crash program to help wipe out a one- to four-century lag in most American mathematics teaching." The program will center on the colleges, developing new curricula not only for students in engineering, science and other specialties but also for training in mathematics of future teachers, from the elementary school through the college level.

[19] Robert B. Davis, "Mathematics for Younger Children," *New York State Mathematics Teachers Journal*, April 1960 (reprint).

[20] Robert B. Davis, "The Syracuse University 'Madison Project'," *American Mathematical Monthly*, February 1960, pp. 178-9.